



Long-term outcome after all inside meniscal repair using the FasT-Fix system[☆]



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ABSTRACT

Purpose: Meniscal surgery is one of the most performed orthopaedic procedures. Because of its chondroprotective properties, meniscal repair should be attempted whenever possible. Several techniques are described in literature, e.g. all-inside repair using FasT-Fix System from Smith & Nephew. The aim of this study was to evaluate the outcome at a minimum of 12 years following meniscal repair using FasT-Fix System.

Materials and Methods: Patients who underwent meniscal repair using FasT-Fix System in the time from 2001 to 2003 were analyzed. We included isolated meniscal tears and combined tears with a concomitant ACL rupture. A median 12-year follow-up was conducted in 2015. Failure was defined as a new surgical procedure to the same meniscus. Moreover, functional outcome was evaluated using the KOOS and tegner activity score (TAS).

Results: At follow-up 27% had undergone further surgery to the repaired meniscus. There was no significant difference between isolated and combined group ($p = 0.582$). The failure rate was significantly higher in females (female 48% versus male 15%; $p = 0.005$). Comparing sports there was a significantly higher failure rate within soccer and indoor sports group ($p = 0.002$).

Comparing isolated and combined injury groups there was no difference in the TAS ($p > 0.05$). Only 1 item of KOOS showed no significant difference: 95.33 versus 94.48 for daily life activities ($p > 0.05$). The other items showed significant differences.

49 out of 51 patients with combined injuries suffered an additional ACL rupture. There was no significant difference regarding the meniscal repair failure rate when comparing the groups of simultaneous and delayed ACL repair ($p = 0.521$).

Conclusions: At 12 years' follow-up 73% had a successful surgery. KOOS was significantly better within isolated meniscus tears. Both groups showed no difference in the TAS. There were no differences regarding failure rate in the comparison of simultaneous or delayed ACL-reconstruction.

1. Introduction

Meniscal lesions are commonly found during knee arthroscopies,¹ in order to treat these injuries arthroscopic partial meniscectomy is one of the most performed orthopaedic surgeries worldwide.^{2–4} However the loss of meniscal tissue can lead to an early onset of osteoarthritic changes in the long term.^{5–8} In pediatric and adolescent patients meniscectomies seem to be even more disadvantageous.^{9,10}

Many studies have shown a chondroprotective effect of meniscal preservation in the recent years.^{11,12} Therefore, meniscal repair should be attempted whenever possible. To perform meniscal repair a variety of techniques were described over the years. In the 1980s arthroscopic techniques were evolved in order to achieve a shorter rehabilitation period, a better visualization and a lower morbidity.^{13,14} In 1980

Charles Henning introduced an inside-out technique,¹⁵ but there was a potential risk of neurovascular injuries. Therefore Russel Warren developed the outside-in technique to reduce neurovascular complications.¹⁶ Finally the all-inside technique was introduced by Craig Morgan in 1991.¹⁷ The procedure was effective but technically demanding. To avoid an additional posterior incision several industrial devices for performing an all-inside meniscal repair were developed – for example the T-Fix device, which was introduced in the mid-1990s.¹⁸ Two anchors were placed near to the tear side and finally tied together. To avoid the manually knot tying the FasT-Fix System (Smith & Nephew) was designed, which attaches two T-Fix suture bar anchors to a nonabsorbable suture. By tightening this suture it forms a tight suture sling between the two T-Fix bars^{19,20} (Fig.1).

The aim of this study was to evaluate the outcome of at least 12

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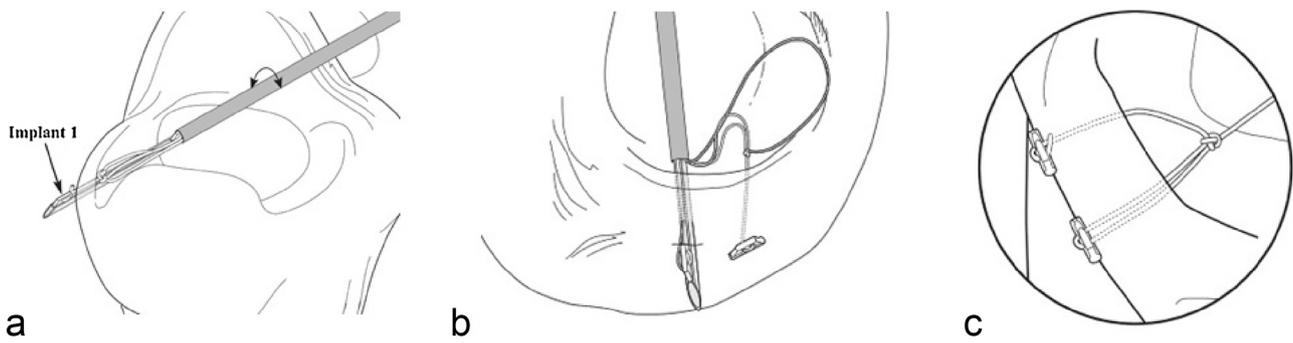


Fig. 1. Scheme of the performed Procedure: a) a needle is pulled through the meniscus releasing implant 1 behind the meniscus b) the needle is inserted approximately 5 mm next to implant 1 on horizontal, vertical or oblique plane in order to release implant 2 c) the needle is removed from the knee and the sliding knot will reduce the meniscal tear (©Smith&Nephew).

years follow-up after meniscal repair using the all- inside FasTFix-System. In addition, we analyzed whether there were any differences between isolated meniscal tears or multiple injured knees.

2. Materials and methods

Between January 2001 and December 2003, a total of 325 patients underwent all-inside meniscal repair using the FasT-Fix System (Smith & Nephew). We retrospectively analyzed these patients at a follow-up of at least 12 years (mean follow-up: 155 months (136–171)). Human research ethics approval was obtained from the local review board (No. F-2015-007, Ethikkommission Landesärztekammer Baden-Württemberg, Germany) prior to the initiation of any study activities. We tried to contact all patients by mail or telephone call and, in addition, data was collected through patient’s medical records. At the time of follow-up the Knee injury and Osteoarthritis Outcome Score (KOOS), Tegner Activity Score (TAS) and failure rates were obtained. Treatment failure was defined as a new surgical procedure to the same meniscus, including repair or resection of the affected meniscus.^{21, 22} Out of the 325 patients 2 patients died during the period of follow-up, 2 patients denied the questionnaire, 90 patients moved away and could not be interviewed and 168 patients did not answer the questionnaire. Therefore, we could include the data of 63 patients in this study. The demographics of the 63 patients are summarized in Table 1. Fig. 2 shows a MRI picture of a vertical posterior horn medial meniscus tear preoperative and one year postoperatively.

2.1. Surgical technique

All patients underwent arthroscopic all-inside meniscal repair using FasT-Fix implants (Smith & Nephew) in accordance with the manufacturers’ technique guidelines if the meniscus was found to have a repairable tear in the red-red or red-white zone (Fig. 3). In the case of a concomitant ACL injury, an ACL reconstruction was performed simultaneous or within six weeks of meniscal repair. The ACL reconstruction was performed using 4- strand gracilis and semitendinosus tendon autografts, fixated with an Endobutton and a bioabsorbable screw.

Table 1 Demographics of patients.

Mean age at surgery (years)	29 (14–49)
Male to female (no)	40:23
Right:Left Knee (no)	34:29
Medial:Lateral Meniscus (no)	42:21
Isolated tear:Combined injury	12:51

2.2. Statistical analysis

Statistical analyses were conducted using the SPSS version 21 (IBM, Armonk, USA). The failure rate and differences in PRO-Scores (KOOS, TAS) were calculated for isolated repairs and those combined with ACL-reconstruction, with 95% confidence intervals (CIs). The paired t-test was used for analysis of quantitative data and chi-quadrat test was used for the comparison of failure incidence in the subgroups of patients. Significance was defined as $p < 0.05$.

3. Results

At a mean follow-up of 155 months 17 out of 63 patients (27%) had undergone further surgery to the repaired meniscus. Approximately the half of the failure-group (53%) reported an adequate trauma that led to the new meniscal tear. Eight out of the 17 failures occurred within the first two years. In all the patients with a second surgery a partial resection of the re-torn meniscus was performed.

Overall the patients showed at follow-up a mean TAS of 5.57 and KOOS subscales of: 91.35 for pain; 86.56 for stiffness; 94.65 for daily life activities; 80.34 for sport and leisure; 77.28 for quality of life.

Looking at gender differences, the failure-rate was significantly higher in the female patients (female 48% versus male 15%; $p = 0.005$). There were no significant differences regarding patients’ age, height and weight ($p > 0.05$).

Comparing the sports, we were able to build three groups: soccer and indoor-sports, alpine-sports and track-and-field-sports. There was a significantly higher failure rate within the soccer and indoor-sports group (soccer and indoor sports 24%, alpine-sports 18%, track-and-field 18%; $p = 0.002$).

3.1. Isolated meniscal repair versus meniscal repair with combined injuries

Combined injuries were found in 81% (51 patients). These included ACL ruptures in 49 patients, an additional lateral meniscus tear in one patient and an additional chondral lesion of the medial femoral condyle in another patient. The latter was treated with microfracturing. The isolated and combined groups showed identical distribution of medial and lateral meniscus tears (2:1). There was no significant difference in the failure-rate between the isolated (33%) and combined group (25%) ($p = 0.582$). Comparing the two groups there was no difference in the TAS (5.75 for the isolated group and 5.53 for the combined group, $p = 0.75$). Only 1 subscale of the KOOS showed no significant difference: 95.33 versus 94.48 for daily life activities ($p = 0.316$). The other items of the KOOS showed significant differences that are presented in Table 2.

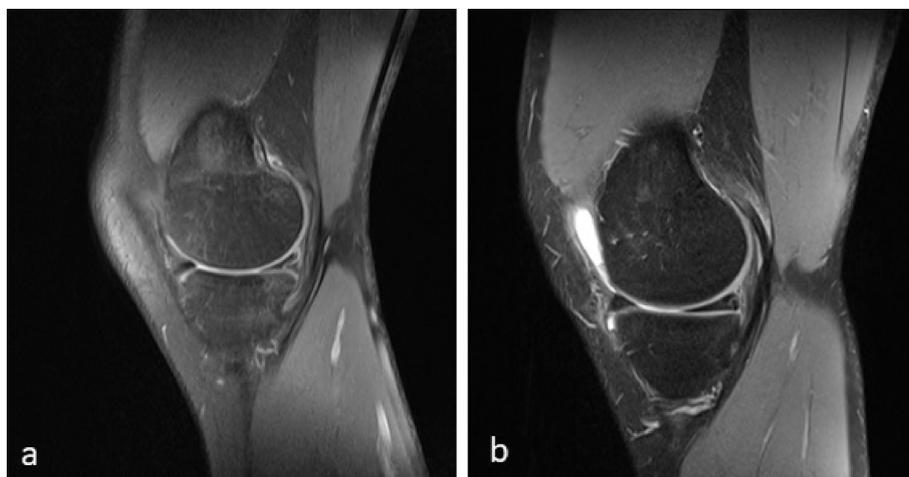


Fig. 2. MRI left knee T2 sag a) vertical posterior horn medial meniscus tear b) one year postoperative meniscus still in place.

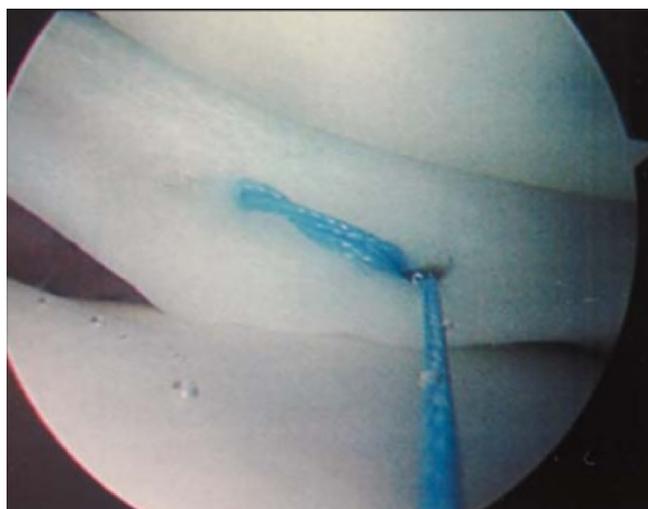


Fig. 3. Intraoperative view showing a horizontal repair of a vertical posterior horn medial meniscus tear.

Table 2
Median KOOS Subscores at the time of follow up.

KOOS subscores	Isolated Repair	Repair with combined Injury	P Value
Stiffness	94,27	85,75	0.003
Pain	96,91	90,53	0.002
Activities of daily living	97,09	94,48	0.316
Sports	90,45	80,14	0.016
Quality of life	88,73	75,44	0.012

3.2. Associated ACL injuries

Within the group of the 49 patients with combined ACL rupture, six had an delayed ACL reconstruction. There was no significant difference with regard to the meniscal repair failure rate when comparing the groups of simultaneous and delayed ACL repairs (failure rate simultaneous ACL repair 26% (11/32), failure rate delayed ACL repair 17% (1/6); $p = 0.521$).

4. Discussion

This study revealed a failure rate of 27% 12 years after meniscal repair using the FasT-Fix System. In the second longest follow-up after

meniscal repair with the FasT-Fix System from Pujol et al. they reported a failure rate of 12.9% after an average of 9.5 years.²³ Bogunovic et al. reported a failure rate of 16% after a follow-up of 7 years.²⁴ There are a few studies showing a failure rate that ranged from 9.5 to 17% after a short- and mid-term follow-up (18 – 30 months).^{20, 25, 26} During a literature review we could only find one study that analyzed a comparable time of follow-up to our study. Solheim et al. found a failure rate of 48% after a follow-up of 10 years using the RapidLoc System from Mitek.²⁷

Our results showed a gender difference regarding the failure rate. Women showed a statistically significant higher failure rate than men. We could not find any study that analyzed meniscal repair and gender differences. We are not able to explain the observed difference at this point of time.

Furthermore, we observed differences regarding the failure rate and performed sport. Patients playing soccer or performing indoor sports showed a higher failure rate than patients doing alpine sport or track and field. None of the studies mentioned above analyzed failure rate and sports. Majewski et al. could show that knee injuries in general occurred in 35% playing soccer and in 26% while skiing.²⁸ Looking at our results we found clearly that soccer and indoor-sports are linked with a higher degree of possible injuries to the knee respectively meniscal tears and acl ruptures than other sports.

Comparing the KOOS values from recent literature of meniscal injuries with our study we can confirm these published results. Pujol et al. reported KOOS subscores in his meniscus repaired patients after a mean follow-up of 9.5 years that are comparable to our results of the isolated meniscal tear group (pain 94.3; stiffness 90.9; daily life activities 98.7; sport and leisure 91.1; quality of life 91.5). However, they did not distinguish between isolated or combined injuries of the knee and meniscal repair was performed using FasT-Fix System only or FasT-Fix System in combination with a non-braided absorbable mattress sutures in contrast to our patients where we included only patients with FasT-Fix sutures only.

Bogunovic et al. distinguished between isolated meniscal repair and repair combined with ACL reconstruction. They could not show any differences regarding KOOS subscores after an average follow-up of 7 years when comparing the two groups.²⁴ These results differ from our results. Within our patients, the isolated meniscal tear group showed better results in four subscores of the KOOS compared to the combined group. We believe that these differences are due to the longer time of follow-up in our study and did not have been marked at the investigated period in Bogunovic' study. Another reason for our superior results in the isolated meniscal tear group could be the fact that it needs more force rupturing an acl than tearing a meniscus alone. Therefore, in the combined group the knee had to endure much more force and was more

seriously injured than knees in the isolated meniscal tear group. This possibly explains why the less serious injured knee showed better results.

Looking at additional ACL injuries, Westernmann et al. reported KOOS values six years after meniscal repair with concurrent ACL reconstruction that are comparable to our combined meniscal tear and ACL reconstruction group (KOOS Symptom 85.7, KOOS Pain 94.4, KOOS ADL 98.5, KOOS Sports 90.0, KOOS QOL 78.1).²⁹

We could not show any significant difference regarding the meniscal repair failure rate when comparing the groups of simultaneous and delayed ACL reconstruction. In Majeed et al.'s study the success rate of meniscal repair was found to be significantly better when ACL reconstruction was performed simultaneously with meniscal repair at a mean follow-up of 9 month. They reported a failure rate of 14% after simultaneous ACL reconstruction and 27% after delayed ACL reconstruction ($p = 0.0006$).³⁰ However, it should be mentioned that in their study the values of each group were related to the totality of all ACL reconstructions and they did not relate the failures to the respective simultaneously or delayed ACL groups.³¹ Therefore, their statement cannot be compared to our results.

5. Limitations

This retrospective study has some limitations. The most important one is the high rate of loss to follow up. We are aware of this bias, but after a follow-up of at least 12 years we expected a higher rate of loss to follow-up than usual. Additionally, failure-rate was defined as the need for revision surgery and patients haven't been clinically and functionally evaluated. Therefore, failure rate overall could be underestimated.

The strength of this study is the long period of follow-up with a mean of 155 months that is the longest reported follow-up period after meniscal repair using the FasT-Fix-System. The second longest reported follow-up, to our knowledge, was 9.5 years on average.²³

6. Conclusions

To our knowledge this is the longest follow-up reported outcome after meniscal repair using the FasT-Fix System. At more than 12 years' follow-up 73% of the patients had a successful surgery. Only a fourth of the patients underwent a new surgical treatment of the injured meniscus. Functional scores were significantly better with isolated meniscus tears than multiple injured knees on four items of the KOOS scale (pain, symptoms, sport and leisure and quality of life). Both groups showed no difference in the tegner activity score. Women had worse results than men. Playing soccer and performing indoor sports have a tendency of higher failure rates. There were no differences comparing failure rates of simultaneous or delayed ACL-reconstruction.

Conflict of interest

The authors have no conflict of interest.

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